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Incidence and Internal Risk Factors of Non-Contact Anterior Cruciate Ligament Injury in Female High School Basketball Players

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Summary:
This injury survey showed the high ACL injury incidence/1000 player exposures of 0.151 in the female high school basketball players, however, the comprehensive examination failed to find the statistical correlation between noncontact ACL injury and the internal risk factors.

Abstract:
Background:
Most studies for anterior cruciate ligament (ACL) injury prevention were designed focusing on the professional or elite college athletes, and reported successfully reducing the incidence of noncontact ACL injury. The post-pubertal females, however, might already be exposed to high risk of ACL injury due to a lack of neuromuscular adaptation to the musculoskeletal growth, and therefore it should be addressed to expand injury prevention measures to the younger athletes. The objective of this comprehensive study was to prospectively investigate the incidence and internal risk factors of noncontact ACL injury in female high school basketball players.

Methods:
A total of 322 female players on 7 high school basketball teams participated in this study. The following possible internal risk factors were evaluated in the screening examination: (1) General joint laxity evaluated with a 7-point test; (2) Anteroposterior knee laxity measured with a KT-1000 arthrometer; (3) Quadriceps angle; (4) Knee joint position sense evaluated by measuring the absolute error in a joint angle replication test; (5) Postural balance examined by measuring the total sway area of the center of gravity during 10-seconds single-leg standing; (6) Isometric maximum knee extension torque normalized by body weight; (7) Isometric maximum knee flexion torque normalized by body weigh; (8) Jumping reaction time measured as the time delay from optical stimulation to toe-off in a vertical jump. Also, the following lower limb kinematics during a jump-landing maneuver were analyzed using a video system: (9) Dynamic varus/valgus leg alignment evaluated by a knee/hip ratio which was the knee separation distance divided by the hip separation distance during a landing; (10) Knee flexion evaluated by a knee flexion index which was the hip-ankle distance at landing divided by the distance at static standing. Subjects were monitored for ACL injury during subsequent 1-year injury survey, and the ACL injury incidence/1000 player exposures and the ACL injury incidence/1000 player hours were determined. The logistic regression analysis was used to find correlation between ACL injury and the possible risk factors with a significance level of 0.05.

Results:
During the injury survey of 1 year, 16 players had noncontact ACL injury in playing basketball. The ACL injury incidence/1000 player exposures was 0.151 and the ACL injury incidence/1000 player hours was 0.047. The screening examination showed 2.4 ± 1.6 and 3.3 ± 1.6 points in the 7-point joint laxity test, 8 ± 2 and 8 ± 2 mm of the anteroposterior knee laxity, 14 ± 4 and 5 ± 4 degrees of the quadriceps angle, 3.1 ± 1.6 and 3.0 ± 1.4 degrees of the absolute error in a joint angle replication test, 6.8 ± 4.3 and 6.6 ± 4.6 cm2 of the total sway area in single-leg balance

test, 3.0 ± 0.6 and 2.8 ± 0.6 Nm/kg of knee extension torque, 1.5 ± 0.3 and 1.4 ± 0.3 Nm/kg of knee flexion torque, 0.55 ± 0.06 and 0.55 ± 0.10 seconds of the jumping reaction time, 0.44 ± 0.10 and 0.40 ± 0.10 of the knee/hip ratio, and 0.70 ± 0.09 and 0.70 ± 0.08 of the knee flexion index for the ACL injured players and the uninjured players, respectively. The logistic regression analysis demonstrated no statistical correlation between ACL injury and the possible risk factors.

Conclusion:
This injury survey showed high ACL injury incidence/1000 player exposures of 0.151 in female high school basketball players, which was comparable to that of 0.22 in the NCAA survey, indicating the necessity for preventive measures in this age population. The comprehensive examination failed to find a statistical correlation between noncontact ACL injury and the examined internal risk factors. The wide range of skill level and playing style in this study subjects might vary the frequency of exposure to events inciting to ACL injury, and consequently mask the contribution of internal risk factors to ACL injury.